PERFORMANCE IMPROVEMENT OF NOMA FOR ADVANCED WIRELESS COMMUNICATION

SHORT SYNOPSIS

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Dipa Nitin Kokane
Registration number: 18/Ph.D/079

Under the supervision of
Dr. Geeta Nijhawan
Professor, Faculty of Engineering and Technology
Dr. Shruti Vashist
Professor, Faculty of Engineering

FACULTY OF ENGINEERING AND TECHNOLOGY

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

SECTOR-43, SURAJKUND –DELHI ROAD, FARIDABAD – 121001

FACULTY OF FET

Certificate

I hereby declare that the short synopsis "Performance Improvement of NOMA for Advanced Wireless Communication "being submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy in Electronics and Communication Engineering under faculty of Engineering Technology of International Institute of Research & Studies, Faridabad during the academic year 2018-19.

It is a bona fide record of original work carried out under the supervision of Dr. Geeta Nijhawan and Dr. Shruti Vashist and has not been submitted in full or part to any other university or institute for degree or diploma. Further, it is certified that short synopsis is plagiarism free and proof has been submitted.

(Dipa Nitin Kokane)
Registration number: 18/PhD/079

Signature of the Supervisor	Signature of the Joint-Supervisor
Full name: Dr. Geeta Nijhawan	Full name: Dr. Shruti Vashist
Designation: Professor	Designation: Professor

(Chairman, DRC)

Chairperson, CDP

ABSTRACT

One of the promising technique for the significant bandwidth efficiency enhancement in future wireless cellular system compared to the conventional multiple access technologies, especially orthogonal multiple access is Non-Orthogonal multiple access (NOMA). NOMA has greater spectral efficiency and more massive connectivity over orthogonal in fading environment. Third generation partnership projects have recently been proposed NOMA for 4G (3GPP-LTE-A). It is a Novel technique focusing the solution for 5G, advanced multimedia applications and Internet of things in terms of supporting massive heterogeneous data traffic. As per the information theory it is expected that the NOMA with SIC at receiver is providing better trade-off between throughput and user fairness compare to orthogonal systems. It is expected that NOMA will effectively overcome Near Far problem in case of cellular system. As per literature survey various schemes of NOMA have been proposed to improve the various parameters of the NOMA system like throughput, complexity, fairness, latency etc. but still none of the scheme is finalized for FRA to meet the desired performance so there is a lot of scope for further improvement. This research work will be carried out to propose a modification in the existing NOMA technique which may further improve the some of the performance parameter.

Key words: Successive Interference cancellation, Superposition Coding, Scrambling, Interleaving, Spreading.

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1. Introduction

From analogue 1st generation wireless phone system to recent Internet Protocol services including voice, message and data transmission, to meet the need of various requirements of the future generation of mobile communication different transmission & reception techniques have been initiated. The rapidly increasing demand for Mobile, Internet and the Internet of Things poses challenging demands for the future wireless radio communication such as higher efficiency of spectrum, more user equipment, large connectivity and higher data rate, reduced latency. The standardization of various generations of radio system for cellular communication are typically characterized by multiple access techniques e.g. 1G technology is Frequency Division Multiple Access (FDMA) used in analogue system, 2G technology is Time Division Multiple Access (TDMA) of digital system, 3G technology named Code Division Multiple Access (CDMA) (Tao , Liu, Liu & Zhang, 2015) based on spread of spectrum for modulation, Space Division Multiple Access (SDMA), 4G is Orthogonal Frequency Division Multiple Access (OFDMA) based on CDMA concept to provide massive user connectivity. Novel NOMA allows a BS to provide service to multiple subscribers using the similar resource block with different power coefficient allocated by various algorithms which are to be multiplexed using SC technique. NOMA guarantee not only that subscribers are served with weak channel conditions but also provide favorable channel conditions can simultaneously apply the similar bandwidth resources to the weak users. This result in NOMA System throughput can also be significantly greater than conventional orthogonal access if fairness of users have been ensured. The idea behind this synopsis is to provide basics of NOMA principles for transmission and reception in which SC precoding and SIC detection techniques were discussed. The rest of the theory paper provides the information about salient feature of NOMA, its classification and comparative overview of various NOMA schemes in terms of key characteristics.

1.1 Background of Multiple Access Scheme

The MA scheme is mainly divided in two categories a) Orthogonal b) Non-Orthogonal

a) Orthogonal MA: OFDM is basically a OMA scheme in which subcarriers are allocated to different users. This subcarrier assignment is further enhanced using adaptive techniques based on the feedback of channel condition to improve the OFDMA performance against the co-channel interference and fast fading effects. CDMA is also using the orthogonal

concept with spread spectrum coding in which single resource is assigned to multiple users with special spread spectrum code for the transmission of data with minimum interference.

b) NOMA: NOMA is broadly classified in two categories one is Cooperative NOMA i.e transmission with the knowledge of wireless network and Non Cooperative NOMA I.e. transmission without the knowledge of wireless network . As stated earlier NOMA supports more users with same recourse simultaneously with different power coefficient. In this scheme user with better channel condition are assigned less power coefficient and each user extract data with SIC receiver.

1.2 Motivation

One of the important challenging issues faced by wireless communication system designer is to increase the efficiency of spectrum of wireless systems. The bandwidth available is rare and expensive, whereas, there is expectation of more data rate in the support of massive subscribers and more multimedia applications. Even though NOMA is not a new approach entirely for wireless system but it is gaining more attraction due to large device connectivity in limited resource block and according to the following motivations.

1) Processing capability of device: To achieve the desire target for FRA, NOMA is utilizing modified transmission and reception techniques such as SIC at receiver which is the baseline of NOMA scheme. But the receiver complexity is one of the major drawbacks of this scheme and it also increases latency which is not desirable. Thus the NOMA feasibility relies on processing capability of device which is expected in future.
2) Multiplexing with additional domain : NOMA utilizes SC in power domain which is not effectively used in previous access techniques so that the users separations is obtained with SIC and various channel codes such as Turbo coding, LDPC to achieve the capacity gain. The gain performance of NOMA is better as compared to orthogonal system under the consideration that the there is a large difference in channel gain which is need to be further explored by enhancing the coding techniques (Higuchi & Benjebbour, 2015).
3) Robust Performance gain: There are many technologies to increase the performance of system such as OFDM, Hybrid Automatic Repeat Request (HARQ) provides high gain irrespective of mobility of UE or latency. These schemes does not rely on instantaneous knowledge of transmitter like quality indicator and state of information of channel (CQI and

CSI) as fine signaling feedback from UE is required. In practical scenario UE feedback signaling do not follow variations due to mobility which is more challenging for wide range of frequency. In this regards NOMA with SIC can be a basic scheme for achieving of robust gain performance.

1.3 Silent features of NOMA:

Improved Spectrum efficiency: NOMA provides a high spectrum efficiency and improved capacity of the system. This is often attributed that NOMA permits each RB (e.g., time/frequency) to be exploited by multiple users.

Fairness:

A key highlight of NOMA is that it strengthens the weak users signal by allocating desired power coefficient. Due to this technique, NOMA is competent of ensuring an alluring trade-off between the fairness among users in terms to achieve greater capacity. There are many advanced techniques of maintaining reasonable fairness.

Massive connectivity:

It is expected that the future wireless system will support the IoT's massive smart device connec tion. Existing NOMA offers a promising alternative design by using its Non-
Orthogonal characteristics to solve this non-trivial task. Non Orthogonal allocation method significantly increases users compare to OMA. It shows that number of users is not limited by the resource blocks availability.

Compatibility:

NOMA can be conjured as an “add-on” method for any OMA techniques (CDMA/OFDMA) from a theoretical perspective. It introduces a new dimension, specially the power domain. As per the develop status of SC for transmission and SIC for reception methods provided in previous literatures, NOMA can be integrated with the MA techniques provided in the old literatures.

Flexibility:

NOMA scheme, such as MUSA , PDMA, and SCMA compare to other multiple access methods it is theoretically interesting and low-complexity scheme. Basically MA schemes and NOMA are quite similar, be dependent on multiple users are using one RB.

Reduced latency and signaling cost: OMA utilizes the scheduling request for the uplink and downlink user's signal transmission which in turn increases the latency & cost of signaling which is not acceptable in massive connectivity system. In some NOMA scheme such dynamic scheduling is not used which in turn reduces the transmission latency as well as signaling overheads.

2. Literature review

Saito, Kishiyama, Benjebbour, Nakamura, Anxin & Higuchi (2013) initially uncovered the NOMA potential for wireless cellular networks and showing that NOMA performs in the form of capacity and fairness. After that researchers around the globe have begun to investigate how the NOMA concept can be transformed into future generation access technique. NOMA works starts by paying attention on single-input single-output (SISO), in which power allocation and user fairness are the major objectives. NOMA Power allocation does not only aim to maximize the sum rate, but take care of user fairness because if NOMA strategy assign maximum power to the strong user then it maximize the sum rate only and no improvement in gain compare to OMA.

Ding, Yang, Fan, & Poor (2014) discussed the NOMA performance using two parameter Outage probability and Ergodic sum rates and verified that NOMA Outage performance and Ergodic sum rate is better than OMA technique under the condition of user rate and power coefficient are properly chosen. However this improvement is possible at the cost of increased complexity due to decoding scheme and performance is also insignificant at low SNR. Thus it is necessary to work on to obtain an tradeoff between performance gain and complexity at various SNRs.

Haci, Zhu, & Wang (2015) proposed the new interference cancellation technique to improve the BER performance of NOMA system. It proposed the triangular SIC technique with itrative signal processing which significantly improve the BER performance over conventional SIC technique.

Dai, Wang, Yuan, Han, Chih-Lin & Wang (2015)provided the detailed comparison of various existing non-orthogonal scheme in terms of feasibility, complexity and key features and concluded that NOMA can be reasonably fulfilled the requirement of spectral efficiency and more connectivity. In NOMA compare to OMA interference can be controlled at the cost of increased complexity.

Timotheou & Krikidis (2015) considers the max-min data rate and min-max outage probability as a performance parameter for downlink NOMA system. The performance of NOMA highly relies on the individual data rate power assignment among the users. It also investigated data-rate under full CSI and outage probability under average CSI.

Tao, Liu, Liu & Zhang (2015) reviewed and compare the NOMA, SCMA and MUSA, PDMA multiple access techniques and summarized its key technology, advantages and disadvantages. In addition to these authors also introduced the three kinds of new modulation waveforms FBMC, UFMC and GFDM supporting to Non-Orthogonal system and mentioned its advantages and disadvantages. But in depth study of these waveforms and multiple access is required for standardization and formulation.

Yang, Ding Fan & Al-Dhahir (2016) proposed a dynamic power allocation method for uplink as well as downlink, which ensures the data rates of all users and it is higher than OMA system. Another future aspect is to work on combining of D-NOMA power allocation scheme with user pairing algorithms.

Song and Wang (2016) compared three interference cancellation techniques which are SIC, Soft in soft out parallel IC and Hybrid IC in terms of delay and complexity. It is concluded that Hybrid IC technique is the better scheme for above parameter.

Yuan, Yu, Hwang, Liao, Li & Takeda (2016) discussed the downlink process of NOMA. Authors focused on multiuser superposed transmission scheme (MUST). Must is divided into 3 categories. In 1st category of MUST coded bits of multiple users are mapped separately to

symbol constellation without gray mapping. In 2nd category of MUST coded bits of multiple users are mapped jointly to symbol constellation with consideration of gray mapping.
In 3rd category of MUST coded bits of multiple users are mapped directly to the symbol to form composite constellation. In the future radio access MUST scheme with some addition of new features will enhance the performance NOMA in downlink transmission.

Shan, Peng, Lin, Jianchi & Xiaoming (2017)provided an comprehensive survey on twelve non-orthogonal uplink schemes categorized in scrambling, interleaving and spreading domain. These schemes give efficient spectrum utilization and more devices connectivity with tradeoff between channel capacity and user fairness. Still a rigorous investigation is going on to improve the performance parameters of NOMA with minimizing complexity and only one or few are considered for future wireless communication.

Haci (2017) proposed a new precoding technology for NOMA systems which targets increase in SNR value of NOMA. The proposed technology is for the reduction of interference for uplink transmission and it is an enhancement of SC-SIC combination for the design of transmitter and receiver structure.

Chen, Bayesteh, Wu, Ren, Kang, Sun, Xuiong, Qian, Yu, Ding, Wang, Han, Hou, Lin, Visoz & Razavi (2018) explain the standardization process of NOMA in which authors have mentioned total 15 scheme proposed by various industries for uplink to meet 3 GPP targets. System level and link level simulation have been performed which proved that parameters are improved compare to OMA with the cost of complexity. In this regards study Item is approved for uplink which works on processing of signals at transmitter, complexity and design of receiver. The authors illustrate the theory of unified framework for NOMA system design which is needed to be explore to achieve desired targets.

Wu, Lu, Jiang, & Shao (2018) classified NOMA scheme in 4 categories as mentioned above and compared these schemes in terms of complexity. It shows that coding and spreading based NOMA are better in terms of more connectivity and robustness. However it is needed to work

on combination of these schemes with LDPC codes, higher order modulation and redundancy scheme (ARQ/HARQ).

Islam, Avazov, Dobre & Kwak (2017) compared the performance of NOMA with Numeric results and described various NOMA challenges which are required to be further explored. It also focus on various implementation issues like Complexity, Error propagation, power allocation algorithm, overhead, user pairing algorithms which is the basis for further research.

Wang, Zhang, Yang & Hanzo (2018) discussed the unified NOMA framework and review the various domains of NOMA scheme in terms of peak to average power ratio, complexity, latency, throughput, load of users and grant free access. The authors concluded that each scheme have certain advantages or disadvantages and used in application specific environment depending on their specific properties. It also mentioned various challenging issues of conventional NOMA system which can be further optimized by converting it into spatial domain for future wireless communication.

2.1 Gaps in literature

There are various NOMA schemes to optimize its various performance parameters as discussed in literature review. The full benefit of the NOMA can be achieved by optimizing various performance parameters such as complexity, fairness, latency, users' fairness etc. The performance parameter like complexity, latency and BER can be optimized by working on the decoding algorithm or structure of the receiver whereas the spectrum efficiency, users fairness and massive connectivity can be optimized by working on the power coefficient algorithm and encoding technique at the transmitter side. As per the literature review each NOMA scheme gives better performance in some parameters with the cost of fairness, interference, complexity and massive connectivity. But none of these NOMA scheme finalized to meet the requirements of advanced wireless communication. While discussing the references it is also observed that there has been a little work on the hybrid architecture to improve above mentioned performance parameter and it is an effective method for balanced trade-off between complexity and system performance. Modification in the existing NOMA system architecture is to be looked into so as to provide better performance. Designing or modification of a robust encoding and decoding

techniques are required to be explored in detail to optimize the performance parameter of NOMA system.

3. Description of Broad Area

Basics of NOMA:

NOMA's basic concept facilitates multiple users' connectivity in the domain of power. It utilizes a novel multiplexing within one of the resource block (time domain/frequency domain). Figure 1 illustrates the real world NOMA system concept for two users. It shows that the base station serves two users in any resource block with different power coefficient allocation depending on the signal strength of the user. As shown in figure 1 user 1 is with higher power coefficient and user 2 is with less power coefficient is allocated at the transmitter side. The receiver is utilizing the concept of SIC in which the user 2 signal is decoded first and then user 1 signal from the observation.

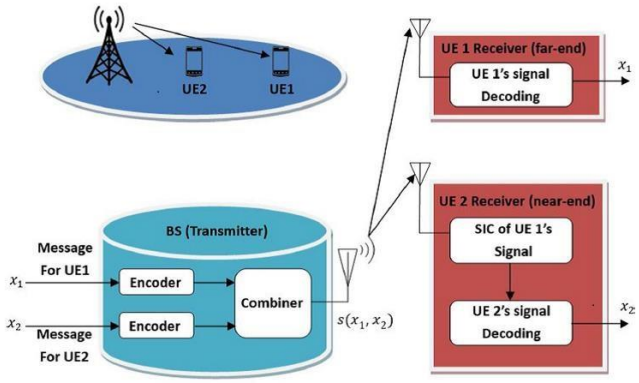


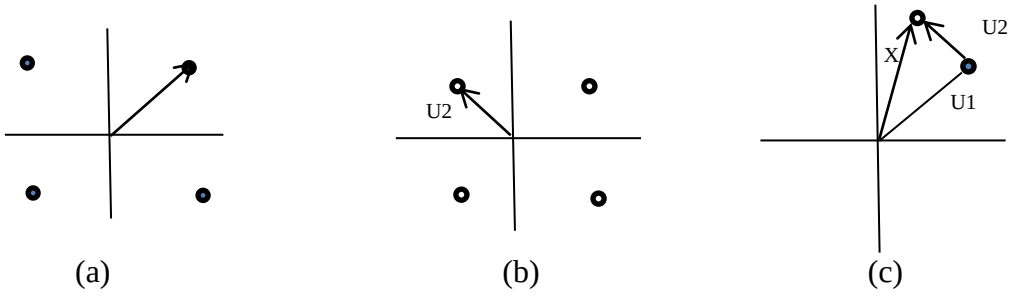
Fig. 1 Basic NOMA Concept (Saito et. al., 2013)

The basic operation of NOMA relies on two key techniques which are SC of multiple users signal for transmitter and SIC for reception (Ping, Liu, Wu & Leung, 2006).

a) Superposition Coding(SC)

The capacity enhancement of a novel NOMA system is relying on superposition coding. It allows to simultaneously transmitting multiple users information by a single resource block with different power levels. NOMA is utilizing the multiplexing concept in power domain and superimposing the users signal. It allocates higher power coefficient to a signal having poor

channel condition and lower power coefficient to another user in case of two user NOMA system and then superposed signal is transmitted. Following Figures of QPSK constellation shows the example of the superposition high power coefficient user 1 signal and low power coefficient user two signal. It is also useful in broadcasting and television system.

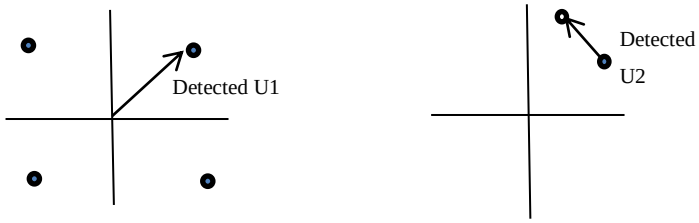


(a) (b) (c)

Fig 2: (a) Signal constellation of UE1 (b) Signal constellation of UE2 (c) Signal constellation of SC Signal

b) Successive Interference Cancellation

In SIC various users' signals are extracted successively. The extracted signal is subtracted from the received signal after detecting one user's signal before performing the next subscriber signal detection. In SIC receiving technique the other subscriber signal is considered to be an interferer and treated as a noise while detecting desired user signal and latter another user signal is decoded with the advantage of having already eliminated the previous signal. Before applying SIC, users are observed according to their strength, so that the stronger signal can be detected initially, and then it is subtracted from the superimposed signal, which segregate the weaker one from the rest. Following Figures of constellation shows the example of the detection of user1 and user 2 signals.



(a) (b)

Fig. 3: (a) Detected UE1 signal (b) Detected UE2 signal

NOMA System Models:

There are various NOMA solutions which are classified into various domains. NOMA is practically classified into single and multiple carriers NOMA. Single carrier NOMA scheme uses only one assigned resource for transmission, i.e. one carrier only. Multiple carriers NOMA utilize multiple resource blocks as a carrier. It may be observed as combinations of NOMA techniques (Hybrid), in which the subscribers of a system are arranged into different groups and each of group served by NOMA concept with the allocation of multiple resource blocks. The inspiration for considering Hybrid NOMA (L. Dai et.al.,2015) is an effective method for balanced trade-off between complexity and system performance. Various examples of single and multiple carriers NOMA are mentioned below in the discussion of classification of NOMA. Figure 4 shows the classification of NOMA techniques. NOMA techniques are classified into four major domains are Scrambling, Spreading (Non-LDS) , Coding(LDS) and Interleaving .

a) Scrambling-based NOMA:

This solution composed of resource Spread Multiple Access (RSMA) of Qualcomm, Low Code Rate and signature based Shared Access (LSSA) of ETRI and power-domain NOMA of NTT DoCoMo as shown in figure. This type of NOMA utilizes various scrambling signature pattern for every user, and uses coding (channel or repetition) for multiple users signal detection. It is performed after modulation in transmitter section. Elementary signal estimator (ESE) or Minimum mean square error (MMSE) with SIC techniques are used for the multi-user detection (MUD) (Ping, Liu, Wu & Leung, 2006).

RSMA makes use of PN long scrambling sequences however; it increases latency and decoding complexity. Hence to minimize complexity as well as latency short the length signature patterns are used in LSSA. RSMA can be single or multicarrier depending on type of application required and it utilizes low cross correlation property of signaling. In uplink Single RB RSMA is always used to minimize the effect of Peak Average Power Ratio (PAPR) and multiple RB. RSMA is used for downlink. NOMA Power domain is a novel scheme whose scrambling multiplication pattern are all ‘‘one’’. It allocates different power coefficient to different user which are having poor channel condition. It utilizes MMSE-SIC MUD technique for detection.

b) Spreading based NOMA :

This scheme utilizes low cross-correlation, non-sparse, non-orthogonal short PN spreading patterns. This solution composed of Multiuser Shared Access (MUSA) of ZTE, Non-Orthogonal Coded Access (NOCA) of Nokia, Non-Orthogonal Coded Multiple Access (NCMA) of LGE, Group Orthogonal Coded Access (GOCA) of Mediatek and Welch Bound spreading multiple access (WSMA) of Ericsson .

It uses different PN sequences for spreading and detecting algorithm for various receiving system. MUSA adopts complex-number spreading and code word level SIC decoding. NOCA uses low-correlation sequences in LTE based on cyclic shift of base sequence (Shan et.al., 2017) and enhanced parallel interference cancellation (MMSE-PIC) method for detection with tolerable amount of error. NCMA generates spreading sequences by Grassmannian line packing problem and MMSE-PIC method for detection. The WSMA utilizes Welch bound spreading sequences and MMSE-SIC for detection of multiusers. The GOCA spreading sequences based on grouped orthogonal concept and MMSE-SIC for detection of multiuser.

c) Coding Based NOMA :

Its unique feature is based on to prepare the codebook (sparse) with overlapped several domains (frequency, time, code, space) for multiple subscribers. This solution is consisting of Pattern Division Multiple Access (PDMA) from CATT, Sparse Code Multiple Access (SCMA) from Huawei and Low Density spreading Signature Vector Extension (LDS-SVE) from Fujitsu, LDS CDMA and LDS OFDM. It adopts the Message Passing Algorithm (MPA) for Multiple User Detection (MUD). Its complexity depends on codebook size. Further the complexity reduced with a Expectation Propagation Algorithm (EPA) approximately roughly similar to the performance of block error rate (BLER) (Meng, Wu, Chen & Cheng, 2017).

PDMA is implemented in multiple domains and uses SIC Amenable multiple access (SAMA). It is designed to improve diversity and minimizing the interference between multiple users. It is used for uplink as well as downlink transmission (X. Dai et al.,2014).

LDS-SVE is the advanced version of LDS designed using larger signature vector. It can be used to exploit diversity of the channel. LDS CDMA is a novel technique of CDMA. LDS CDMA utilizes sparse spreading sequence rather than dense spreading sequence to minimize the interference (Y. Wang, 2011)

LDS OFDM is a hybrid version of LDS CDMA and OFDM to improve spectral efficiency (Hoshyar, Wathan & Tafazolli, 2008).SCMA technique directly maps the coded multiple users

data to the complex multidimensional code word according to the lookup table for different sparse codes in time, frequency domain. It improve performance, gain reasonably by using multidimensional constellation, LDS concept (Al-Imari, Xiao, Imran & Tafazolli, 2014). It is applicable in both uplink and downlink transmission

d) Interleaving Based NOMA :

In this technique multiple interleave channels are overlapped for different users data transmission and channel coding with low rate is used for detection. This solution composed of IDMA from Nokia, IGMA from Samsung, LCRS from Intel and RDMA from Mediatek with basic characteristics of IDMA.

IDMA is a first interleaving NOMA scheme, which makes use of random interleave patterns to distinguish different users. SC is used for data transmission and low-complexity ESE algorithm used for MUD and estimate log-likelihood ratio (LLR).

RDMA utilizes a repetition pattern with cyclic-shift to distinguish users' signals and uses both frequency and time diversity. SIC technique is used for MUD whereas SC is used for data transmission. LCRS adopts bit level interleaving, repetition, channel encoding and modulation for every user. MMSE-PIC is used for MUD. A Comparative table for key characteristics of various NOMA scheme is shown in table 1.

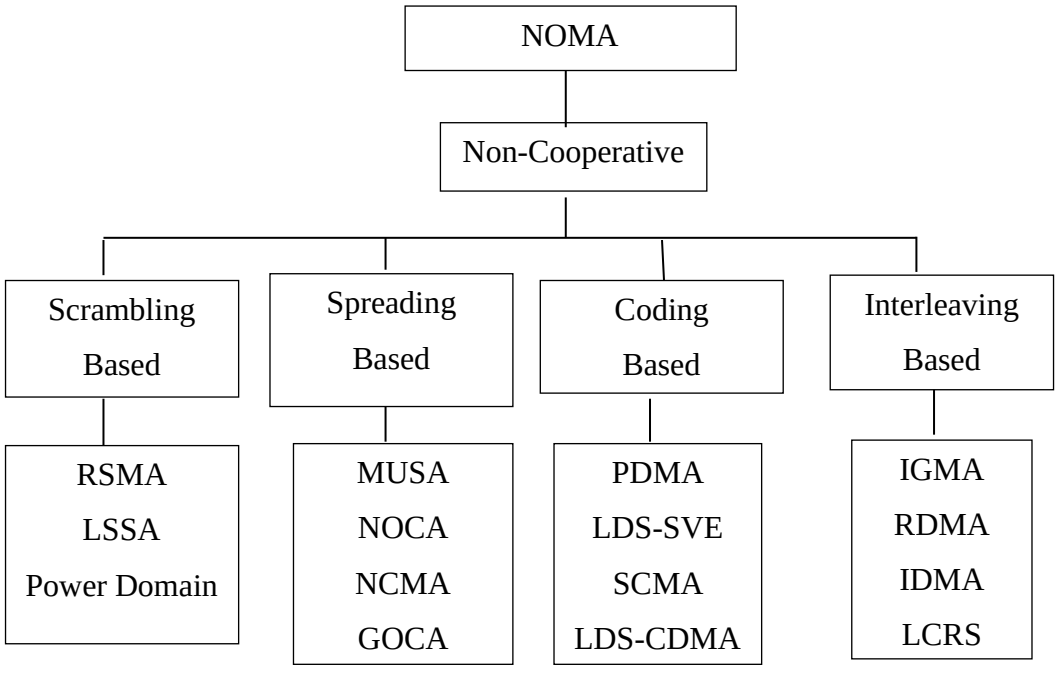


Fig 4: NOMA classification

Table 1: Key characteristics comparison of various NOMA scheme

NOMA Techniques	Affiliation	Carrier	Decoding Algorithm	Complexity	Basic user Differentiation
RSMA	Qualcomm	SC/MC	ESE	Low	Low rate scrambling and channel codes are used.
LSSA	ETRA	SC	SIC	Low	Bit by bit or symbol by symbol level multiplexing with specific signature pattern.
Power Domain	NTT DOCOMO	SC	MMSE-SIC	Low	Multiple Subscribers signal with different power coefficient are transmitted
MUSA	ZTE	SC	MMSE-SIC	Medium	Use short length complex PN code for transmission.
NOCA	Nokia	SC	MMSE-PIC	Medium	Use LTE low correlation sequence as a spreading code.
NCMA	LGE	SC	MMSE-PIC	Medium	Grassmannian line packing problem is used for spreading code.
GOCA	Mediatek	SC	MMSE-SIC	Medium	Group orthogonal sequences along with spreading symbols
WSMA	Ericsson	MC	MMSE-SIC	Medium	Welch Bound sequences are generated.
PDMA	CATT	MC	MPA	High	Each code with sparse mapping and particular diversity order is transmitted.
LDS-SVE	Fujitsu	SC	MPA	High	Extended signature vector

SCMA	Huawei	MC	MPA	High	Low Density data stream as per lookup table(codebook) is transmitted.
IGMA	Samsung	SC	ESE	Low	Bit level interleaving and grid mapping pattern codes are used.
RDMA	Mediatek	SC	SIC	Low	Frequency and time diversity with cyclic shift repetition codes are used
IDMA	Nokia	SC	Complex ESE	Low	Bit level interleaving codes are used.
LCRS	Intel	SC	MMSE-PIC	Low	Use direct PN sequence spreading symbols.

4. Objectives of the Study

4.1 Problem Formulation

To improve the performance of NOMA there is a possibility to work on performance indicators of NOMA systems .These Key performance indicators includes throughput, sum rate, error rate, outage probability, latency, complexity, interference and fairness.

The objectives of this research work are:

1) To do the extensive literature survey on the work related to various NOMA Schemes.
2) To compare various NOMA scheme and identify the performance parameters like Spectral Efficiency, Throughput, Sum Rate, Error Rate, Outage Probability, Power allocation etc. which are to be improved.
3) To design hybrid scheme for the improvement in the performance of the NOMA system.
4) To improve the efficiency of the NOMA technique by optimizing identified parameters.
5) To investigate the effect of NOMA with Cognitive Radio or IOT and optimize their performance for various indoor applications.

5. Methodology to be adopted

1) The study focused on comparative analysis of Various NOMA scheme and identifying best NOMA schemes based on the performance key indicators like Throughput, Sum Rate, Error Rate, efficiency, latency, Complexity etc.
2) The proposed work is modeled by hybrid schemes to improve the any two or more performance key indicators as mentioned above.
3) The efficiency of the NOMA technique is improved by optimizing resources like users pairing, power allocation or frequency allocation.
4) The combining effect of NOMA with cognitive radio or IOT is investigated and its performance is optimized for indoor application.

6. Expected outcome of the research

During the study of the various NOMA scheme in terms of different performance parameter like throughput, latency, power allocation scheme, coding scheme, BER, efficiency, users fairness, interference etc. two to three parameters are identified. A modification or new algorithm and hybrid scheme may be proposed to improve the overall performance of NOMA system. The proposed NOMA is combined with Cognitive Radio or IOT to optimize the performance of indoor application.

Proposed Time Frame

Time Frame	Dec18 June 2019			July -Dec 2019			Jan–June 2020			July –Dec 2020			Jan–June 2021			July –Dec 2021			Jan–June 2022			July –Dec 2022		
Months	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
Year	1						2						3						4					
Course Work																								
Literature Survey																								
Review Paper Based on literature survey																								
Base paper Implementation for achieving Objective 1																								
Objective 2																								
Objective 3																								
Objective 4																								
Objective 5																								
Miscellaneous Works																								

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PERFORMANCE IMPROVEMENT OF NOMA FOR ADVANCED WIRELESS COMMUNICATION

SHORT SYNOPSIS

by

Dipa Nitin Kokane
Registration number: 18/Ph.D/079

Under the supervision of
Dr. Geeta Nijhawan

ABSTRACT

One of the promising technique for the significant bandwidth efficiency enhancement in future wireless cellular system compared to the conventional multiple access technologies, especially orthogonal multiple access is Non-Orthogonal multiple access (NOMA). NOMA has greater spectral efficiency and more massive connectivity 11r orthogonal in fading environment. Third generation partnership projects have recently been proposed NOMA for 4G (3GPP-LTE-A). It is a Novel techniq 10 focusing the solution for 5G, advanced multimedia applications and Internet of things in terms of supporting massive heterogeneous data traffic. As per the information theory it is expected that the NOMA with SIC at receiver is providing better trade-off between throughput and user fairness compare to orthogonal systems. It is expected that NOMA will effectively overcome Near Far problem in case of cellular system. As per literature survey various schemes of NOMA have been proposed to improve the various parameters of the NOMA system like throughput, complexity, fairness, latency etc. but still none of the scheme is finalized for FRA to meet the desired performance so there is a lot of scope for further improvement. This research work will be carried out to propose a modification in the existing NOMA technique which may further improve the some of the performance parameter.

Key words: Successive Interference cancellation, Superposition Coding, Scrambling, Interleaving, Spreading.

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